Analyzing citizens' views on new spatial-infrastructure projects:

From the average view towards various clusters within the Participatory Value Evaluation Method

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Abstract

This study identified the distribution of citizens for the allocation of the public budget towards spatial-infrastructure projects using the Participatory Value Evaluation (PVE) tool. The dataset of a PVE experiment in the Region of Amsterdam (Vervoersregio Amsterdam) is used. A Latent Class Cluster Analysis model was estimated to identify citizens selecting a similar combination of spatial-infrastructure projects. The results of this study found that individuals are more likely to select projects in their living area. Furthermore, individuals prefer rather a higher number of projects having low costs than one expensive project, and individuals assign high values to safety compliance projects. The results indicate individuals do neither necessarily base their choice on quantitative attribute values, such as minutes of travel time reduction realized by a new project, nor do individuals select a combination of projects based on travel mode improvements realized by these projects. By doing experts' interviews, this study also provides a rich reflection of the implications of the clusters identified. The desirability of the location-effect depends on the aim of the experiment. The main implication of the results is that researchers have to be aware of the strong location-effect and that future research should control for this effect.

Keywords: *Decision-making, Infrastructure policy, Participatory Value Evaluation, Latent Class Cluster Analysis, Preference Assessment*

1. Introduction

The local government strives to improve the regional urban network while making the best use of the public budget (Van Wee, 2012). Traditional Cost-Benefit Analysis (CBA) remains one of the most popular evaluation methods for new infrastructure projects (Mouter et al., 2017; Annema et al., 2015). However, researchers criticize the monetizing principle (by using the private willingness-to-pay (WTP) approach), which is based on individuals' private budgets while infrastructure projects are realized from governmental budgets. Citizens' preferences using their private budget does not accurately reflect their expectations for governmental spending for public infrastructure (Alphonce et al., 2014; Mouter & Chorus, 2016). Participatory Value Evaluation (PVE) is a novel designed evaluation tool specifically designed to overcome this problem with CBA while preserving the positive aspects (Mouter et al., 2019). PVE involves citizens by asking them to advise the local government about the allocation of a fixed amount of public budget towards transportation projects. Consequently, the setting of PVE should more accurately reflect citizens' preferences for governmental spending. The analysis of PVE shows a portfolio of infrastructure, which should maximize social welfare increase (Mouter et al., 2019).

However, the portfolio presented by PVE only shows the projects that are highest ranked on average, which does not account for the distribution of preferences. Consequently, misinterpretations of citizens' preferences are risked. For example, if 80 percent of the citizens prefer car projects, while the remaining 20 percent prefer public transport projects, the average result would show that a portfolio including only car projects would maximize the welfare since the majority prefers car projects. The welfare analysis does not account for the structural loss of the remaining 20 percent. Eventually, the welfare analysis of the optimal portfolio does not account for the equal distribution of welfare (Kaplow, 2010). However, alternative evaluation methods like CBA are not able to provide this information either

(Nyborg, 2012). However, decision-makers should understand the distribution of citizens' preferences for better facilitation of the democratic decision-making about public budget, of which PVE assumes all citizens to be co-owner (Mouter, 2019; Nyborg, 2012). However, considering all citizens' views separately would take too much time from busy politicians (Nyborg, 2012). There is a need for structural evaluation of citizens' preferences for spatial-infrastructure projects that covers the distribution of these preferences.

This study tries to identify homogenous groups of citizens, selecting a similar combination of projects based on project-specific characteristics. The groups show to what extent individuals select projects based on travel mode improved, project location, or quantitative project attributes such as the minutes of travel time reduction. Subsequently, background characteristics that are related to the heterogeneity between the identified clusters are explored. These background relations show to what extent project preference is related to individuals' political orientation, favorite mode, or living area. For example, whether bikers select only bike projects, individuals living in remote areas more likely to select projects in remote areas or environmentalism-orientated individuals select projects having minimum environmental impacts.

This study aims at contributing to the literature by analyzing distributed profiles of preferences among citizens for the allocation of the public budget towards spatial-infrastructure projects using the Participatory Value Evaluation. This study helps in understanding the conflicting preferences among citizens and creates the opportunity to debate the best mix of infrastructure for people in a scientific way. Moreover, the analysis provides scientific insights into the degree of disagreement regarding budget allocations to spatial-infrastructure projects of the citizen in general. Furthermore, the implications of the distributed profiles of preference, if identified, are presented on the basis of several experts' reviews.

In the following sections, the applied methodology, including the Latent Class Cluster Analysis (LCCA), expert interviews, and the case study, are described. Subsequently, the quantitative results of the LCCA model are presented. Then, the experts' reviews on the implications based on the clusters, if identified, are presented. The final sections provide conclusions and discussions on the results.

2. Methodologies and data

This study applies a quantitative analysis of the data to identify distributed profiles of preferences. Subsequently, the implications of the results are reviewed by experts, which is a qualitative analysis.

2.1 Latent Class Cluster Analysis

A LCCA model is applied to identify the distributed preferences for public budget allocation towards spatial-infrastructure projects.

The LCCA maximizes homogeneity within the clusters and the heterogeneity among the clusters. Within the model, a discrete latent variable accounts for the associations between a set of indicators. Conditional on this variable, the associations become insignificant according to the assumption of local independence (Vermunt & Madigson, 2002). The clusters show individuals having a similar response pattern, which enables LCCA to identify groups of respondents selecting similar combinations of spatial-infrastructure projects. Furthermore, the LCCA presents statistical criteria to choose the number of clusters (Kroesen, 2019). The cluster model is estimated using the dedicated software Latent Gold (Vermunt & Magidson, 2005).

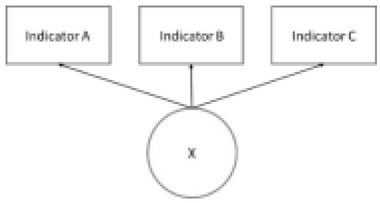

Figure 1 LCCA including three indicators and latent class cluster variable X

First, the model that includes only indicators is estimated to assess only the measurement part of the model, as presented in figure 1 (Molin et al., 2016). Based on this model estimation, the optimal number of clusters is determined using two types of criteria. The prior applied method to assess model fit in case of sparse data is the Bayesian Information Criteria (BIC), which weight model fit and parsimony in terms of the number of estimated parameters (Molin et al., 2016). However, if the BIC criteria show a high number of clusters that are too complex to communicate, the BVR's as a local measure of model fit is applied (Molin et al., 2016). The Chi-square distributed BVR's were estimates of the improvement of model fit when a direct effect between two indicators was included. The number of significant BVR's (>3.84) and the highest BVR value are included as additional indicators to determine the optimal number of classes.

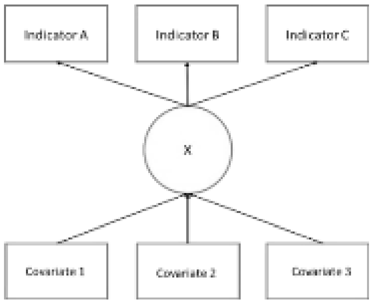

Figure 2 LCCA model including covariates

Subsequently, as presented in figure 2, the model is expanded by adding covariates to the model, which represents the structural part of the model. It is assumed that individuals have a probability of belonging to each class, depending on their background characteristics. These observed characteristics are called covariates (Molin et al., 2016).

Wald statistics are used to determine whether the indicators and covariates within the model are significant. The corresponding p-values assess whether or not scores differ significantly across clusters (Molin et al., 2016). The traditional value of 5 percent is used.

2.2 Semi-structured interviews

Qualitative semi-structured interviews with experts are conducted to review the results of the estimated cluster model. The interviews aim to consider whether the implications of the results are desirable for the scientific evaluation of citizens' preferences for spatial-infrastructure projects and to further substantiate PVE as an evaluation method and policy-making instrument. Three different points of view are approached for the interviews, being 1) a scientific PVE expertise, 2) a scientific CBA expertise, and 3) policymaking expertise. The aim of the interviews is to find out respectively 1) the implications for the scientific evaluation of citizens' preference and using PVE, 2) the implications for scientific evaluation and the fit of PVE from an alternative perspective, and 3) the practical implications for policymaking. One interview with a PVE expert, one interview with a CBA expert, and two interviews with two policymaking experts were conducted in January 2020.

2.3 Data case study Vervoerregio Amsterdam

An experiment should be carried out on a regional level since infrastructure projects are predominantly developed on a regional scale. Furthermore, different travel modes should be proposed to identify if individuals have a preference for a particular travel mode. The area of the case should have a relatively high number of inhabitants to gather responses. Therefore, Vervoerregio Amsterdam is selected as a case study. The data of a recent PVE experiment in Vervoerregio Amsterdam of Mouter et al. (2019) is used. Each of the 16 projects included focuses on the improvement of public transport, car, active modes, active mode safety, or safety compliance. Figure 3 presents an overview of the geographical location of the projects and the mode improved by the project.

The survey design included a short instruction movie about the idea of the survey. Subsequently, an overview of projects is presented, including the project titles of table 1.

Individuals could read more information about the project by selecting a project or compare some projects based on quantitative attribute values. Individuals had to select projects within a fixed budget of 100 million. Participants were aware that the budget not allocated would be shifted to the budget of the next year for transportation projects. Two different experiments of Mouter (2019) were used, one including only one design of parameters and a second using multiple designs for project attribute values. The use of multiple designs indicates that respondents received one of the 64 designs for the attribute values.

Table 1 The 16 project included in the PVE experiment selected in collaboration with Transport Authority Amsterdam (TAA)

NR.	COSTS	PROJECT DESCRIPTION
1	50	Faster connection bus and car traffic Zaandam
2	3	Ilpendam pedestrian tunnel
3	40	Fly-over A10 at junction Amsterdam Noord
4	10	Extending the MacGillavrylaan to Middenweg
5	10	Widening the Bovenkerkerweg to 2 lanes per direction
6	50	New bus connection Ijburg – Bijlmer Arena
7	5	Acceleration of the bus connection Amsterdam CS – Zaandam

8	15	Improvement tram connection Diemen- Linnaeusstraat
9	8	Cycling highway Hoofddorp – Schiphol – Aalsmeer
10	6	Cycling highway Amstelveenseweg
11	4	New bridge for cyclists and pedestrians Purmerend (Hoornselaan)
12	40	Guisweg bike tunnel
13	35	New cycling bridge Zeeburg
14	40	Stadhouderskade car tunnel at the entrance of the Vondelpark
15	50	Traffic education for children in the age group 4 – 18
16	20	Five police officers sanction violation of traffic regulations

Figure 3 Geographical locations of projects and travel mode improved. No location is assigned to safety compliance project numbers 15 and 16

2.4 Data analysis

First, the dataset is cleaned. Individuals shifting the full budget to the next year by not selecting any project are excluded from the dataset. These responses are assumed to be outliers since these are not suitable for the evaluation of what kind of spatial-infrastructure projects are preferred by citizens. In total, 6 respondents were removed and excluded from the dataset. Consequently, 1037 number of observations were used for the analysis. Table 2 summarizes the descriptive statistics of the socio-demographic background characteristics.

Table 2 Descriptive statistics socio-demographic background characteristics

DEMOGRAPHIC VARIABLE	CATEGORIES	DISTRIBUTION SAMPLE
AGE	18-25	4.53 %
	25-45	26.81 %
	45-65	41.85 %
	65-80	24.69 %
	80+	2.12
GENDER	Male	54.97 %
	Female	45.03 %
INCOME	Average income	46.57 (x €1000)
EDUCATION	No/elementary education/LBO/VBO/VMBO	7.86 %
	MAVO/VMBO/MBO1	8.68 %
	HAVO/VWO/MBO2,3,4	28.45 %
	HBO/WO bachelor	33.46 %
	WO master	21.02 %
LIVING AREA	Zaanstad	15.12 %
	Purmerend	9.61 %
	Amsterdam West	31.89 %
	Amsterdam Oost	13.13 %
	Haarlemmermeer	20.52 %
	Amsterdam Zuid-Oost	9.85 %

The chi-square tests are applied to test if the sample is representative compared to the population of Vervoerregio Amsterdam (CBS, 2019). These tests showed that males and high educated respondents were overrepresented. Furthermore, the average income of respondents was significantly higher, and living areas Zaanstad, Amsterdam Zuid-Oost were overrepresented, while Amsterdam West and Amsterdam Oost were underrepresented. However, all categories are presented in the sample. Consequently, all categories can be included in the analysis. Although, average results should correct for significant background characteristics that are not representative.

3. LCCA model estimation & results

Three different LCCA models are estimated. The models differ in terms of indicators included in the model. The included covariates are similar. First, a model based on specific project selection is estimated. Project choices are included as indicators to show a combination of projects selected by individuals. The common characteristics of the projects selected are reviewed in the cluster interpretation.

3.1 Project selection

A cluster model is estimated, including all 16 projects as indicators of the model. Each project choice was added as a binary variable. Consequently, the model contains 16 indicators. According to the BIC values of table 3, 9 clusters would be the optimal number of clusters. However, that number of clusters is too complex to communicate. Therefore, the number of significant BVR's and the maximum BVR value, presented in table 3, are considered as well. After 7 clusters, the BIC, maximum BVR, and in particular, the number of significant BVR's does not decrease a lot. Consequently, the number of 7 clusters is selected.

Table 3 BIC and BVR values as criteria to determine the optimal number of clusters

NUMBER OF CLUSTERS	BIC	#BVRS>3.84	MAX BVR
1	19254	91	87
2	18721	68	60
3	18526	45	69
4	18382	36	51
5	18320	33	59
6	18295	41	46
7	18282	29	51
8	18279	28	47
9	18253	27	52
10	18305	25	48

The Wald test statistics and corresponding p-values indicate that all 16 indicators are significant. Consequently, the cluster values per project choice indicator differ significantly over the clusters. The cluster values of table 4 present per indicator the average score for a project per cluster between 0.00 and 1.00. The higher the score, the more frequently the project is selected by individuals belonging to the cluster.

Table 4 Cluster profiles based on project selected

CLUSTER NR	1	2	3	4	5	6	7	WALD VALUE	P VALUE
CLUSTER SIZE	0.26	0.16	0.16	0.13	0.11	0.10	0.08		
PROJECT NR									
1	0.03	0.08	0.06	0.52	0.00	0.00	0.13	101.14	0.00
2	0.21	0.13	0.74	0.27	0.63	0.68	0.69	181.26	0.00
3	0.17	0.16	0.28	0.34	0.00	0.00	0.54	51.91	0.00
4	0.44	0.09	0.63	0.06	0.70	0.45	0.27	103.93	0.00
5	0.08	0.26	0.61	0.07	0.48	0.50	0.08	147.51	0.00
6	0.24	0.04	0.17	0.01	0.00	0.00	0.00	24.17	0.00
7	0.20	0.06	0.56	0.56	0.53	0.48	0.28	103.85	0.00
8	0.29	0.04	0.47	0.05	0.54	0.21	0.05	104.35	0.00
9	0.12	0.43	0.71	0.04	0.55	0.66	0.07	164.34	0.00
10	0.16	0.30	0.59	0.13	0.68	0.51	0.16	141.98	0.00
11	0.18	0.09	0.68	0.27	0.52	0.56	0.64	150.76	0.00
12	0.05	0.10	0.30	0.60	0.05	0.00	0.20	116.48	0.00
13	0.47	0.15	0.41	0.09	0.19	0.00	0.04	79.99	0.00
14	0.54	0.62	0.02	0.08	1.00	0.00	0.34	66.34	0.00
15	0.24	0.57	0.00	0.21	0.00	1.00	0.45	50.29	0.00
16	0.30	0.19	0.48	0.16	0.62	0.79	0.22	119.71	0.00

The Wald statistics of the included covariates, presented in table 5, show that individuals' living area, level of education, age, gender, car ownership, and expectation to move do significantly predict class membership. The other covariates are not significant. Remarkable is that individuals living areas are significant, while individuals' political orientation and favorite travel mode are not.

Table 5 Wald test of covariates

COVARIATES	WALD	P-VALUE
ORIENTATION	51.31	0.15
LIVING AREA	137.01	0.00
FAVORITE TRAVEL MODE	27.31	0.29
EDUCATION	61.70	0.00
AGE	27.18	0.00
INCOME	10.67	0.10
GENDER	16.47	0.01
EXPECT TO MOVE	25.61	0.01
CAR OWNERSHIP	34.56	0.00
DRIVING LICENSE	19.02	0.09
PT COMMUTATION	15.98	0.19

Clusters identified

Table 6 shows the cluster sizes, a cluster description that characterizes the combination of projects predominantly selected, and the living area and demographic groups that predominantly belong to the cluster.

Table 6 Cluster interpretation

CLUSTER	CLUSTER SIZE	DESCRIPTION	LIVING AREA	DEMOGRAPHIC VARIABLES
1	26 %	Projects within Amsterdam	Amsterdam Oost + Amsterdam West	High educated, No car owner, Expectations to move
2	16%	Traffic education & Stadshouders kade	Amsterdam West and Haarlemmer meer	Women, Age 20-30
3	16%	Many cheap projects scattered over the area	-	Men, High educated, Middle age
4	13%	Accessibility Zaanstad	Zaanstad	Low educated, Elderly, Car owner
5	11%	Stadshouders kade and cheap projects close to Amsterdam	Amsterdam West	High educated, Men
6	10%	Traffic Safety combined with cheap active mode projects	Haarlemmer-meer (*slight overrepresented*)	Age 20-40
7	8%	Accessibility Purmerend	Purmerend	Elderly, Low educated

The cluster characteristics show that the location of the projects selected directly overcomes the living area of individuals that are most likely to belong to the cluster for cluster numbers 1, 4, and 7. The results show that individuals are more likely to select projects in their living area. However, alternative strategies are visible either. Table 7 presents an overview of the (combination of) strategies applied by each cluster.

Table 7 Applied strategies per cluster

CLUSTER	CLUSTER SIZE	PROJECTS WITHIN THE LIVING AREA	SAFETY COMPLIANCE PROJECTS	AS MANY CHEAP PROJECTS
1	26 %	X		
2	16%	X	X	
3	16%			X
4	13%	X		
5	11%	X		X
6	10%		X	X
7	8%	X		
TOTAL		63 %	26%	37%

Individuals seem to attach much value to safety compliance. Furthermore, many individuals decided to select many cheap projects, which are mostly spread over the region, which strategy indicates a preference for 1) many projects over one prestigious project and 2) spatial-equality of budget allocation over the region. The demographic background characteristics show that high educated individuals are more likely to select several-low costs projects, while low educated more likely select projects within their living area.

Besides, the demographic background characteristics show women and individuals between the age of 20 and 40 are more likely to select safety compliance projects. The variables 'car ownership' and 'expect to move' do only differ among individuals living in Amsterdam. More data is required to identify if this relation also occurs in other living areas.

3.2 Cluster models based on quantitative attribute values or travel mode preference

A second LCCA model based on quantitative attribute preference is estimated. Quantitative attribute values were included as indicators of the model showing whether participants prefer projects based on one of the qualitative attribute values, as presented in table 8.

Table 8 Indicators model quantitative attributes

ATTRIBUTE	DESCRIPTION
TRAVELERS	Number of travelers with reduced travel time on an average working day
TIME SAVINGS	Average minutes of travel time gained by travelers
DEATHS	The average reduction of traffic injuries
INJURIES	The average reduction of traffic deaths
NOISE	Increased number of households that experience noise pollution
TREES	Number of trees that have to be cut

Nevertheless, no clear clusters based on attribute values were visible. The cluster presented seem to be related to alternative project characteristics, like safety improvement. Consequently, individuals seem not to base their choice for a project on quantitative project attributes.

A third LCCA model based on travel mode preference is estimated. The travel modes included are presented in table 9. It is assumed that the total budget allocated to a travel mode reflects the relative preference for the travel mode. In addition, the remaining budget shifted to the next year is included as an additional indicator of the model.

Table 9 Indicators of the model based on travel mode preference

TRAVEL MODE	DESCRIPTION
PUBLIC TRANSPORT	New or acceleration of tram and bus lines
CAR	Faster connections for car traffic, improvement in car traffic flow
ACTIVE MODE	New cycling connection or highways to improve the cycle traffic flow
ACTIVE MODE SAFETY	Separate car and cycle/pedestrian traffic lanes to reduce the number of accidents due to collisions
SAFETY COMPLIANCE	General safety instruction and control

The results showed clusters which were strongly related to individuals living area. Consequently, the clusters appear to reflect groups of individuals selecting projects in their living area. No clusters of individuals having a preference for a particular travel mode were visible. However, the model did show a large cluster allocating a large share of the budget towards safety compliance projects.

Cross-table based on posterior membership

Posterior membership classification of the first and the third model were used to construct a cross-table of clusters, being the project choice model and travel mode preference model. The cross-table analysis shows if individuals are classified to a similar cluster in the first model as in the third model. The analysis aims to show if the two models estimate similar clusters. The results showed similarities in clusters. Both models show a strong relationship with individuals living areas and projects selected. However, the cross-table showed that individuals of participants of all clusters in the first model belong to the safety compliance cluster in the second model. Consequently, the first model based on project choice underestimates the preference for safety compliance. Whereas the project choice model can show individuals selecting many projects having low costs since the project choice model better reflects specific projects selected by a cluster. However, both models show a similar effect of individuals having a preference for projects in their living area.

3.3 Location-effect

The results show that individuals are more likely to select projects in their living area. However, the results do not clearly show the share of individuals selecting only projects in their living area. The statistics of table 10 clearly shows that individuals do not just select all projects in their composed portfolio of projects. Only 15 to 28 percent selected all projects in their living area. However, 60 to 92 percent selected at least one project within their living area. In conclusion, individuals intend to include a project located in their living area in their portfolio.

Table 10 Distribution of individuals selecting all projects within their living area

PROPOSED PROJECTS (#)	LIVING AREA	NUMBER OF PROJECTS WITHIN LIVING AREA SELECTED			
		All (%)	At least 2 (%)	At least 1 (%)	0 (%)
3	Zaanstad	16	81	92	8
	Purmerend	28	74	94	6
	Haarlemmer meer	24	58	88	12
2	Amsterdam Oost	26	-	80	20
	Amsterdam Zuid-Oost	8	-	63	37
1	Amsterdam West	60	-	-	40

4. Interview results and reflection

The results are reviewed by experts. The interview aims to reflect the implications of the results, showing a strong location-effect. The interviews are used to reflect whether it is desirable that individuals select projects in their living area.

4.1 Implications evaluation citizens preferences

The two main implications are that 1) welfare increase of projects located in living areas that are overrepresented in the sample is overestimated and 2) projects in high populated areas are more likely to end up in the optimal portfolio, while expensive projects in remote areas end up in the bottom of the ranking of projects.

The scientific CBA expert and the scientific PVE expert argue that the first implication is problematic. Therefore, the PVE analysis to determine the optimal portfolio should correct for the representative living area for an accurate ranking of projects on average preferred by citizens.

All the experts agree that the second implication is not problematic since more individuals benefit in these areas. The CBA expert argues the budget allocation should be proportional, however, if the optimal portfolio would include only projects in high populated areas, it is not the problem of the evaluation tool itself, but up to policymakers to correct for proportional distribution. The policymakers mention that indeed a large share of the budget is allocated to highly populated areas. However, the regional government is responsible for maintaining the regional network as a whole. Consequently, not all budget is allocated to projects in high populated areas.

Apart from this, the experts reviewed to what extent it is desirable individuals select projects in their living area. The PVE expert argues that participants should be allowed to select projects in their living area. In contrast, the CBA expert argues it is not desirable only to measure that citizens prefer projects in their living area since there are less complex tools to measure that effect. Policymakers argue that the information that individuals prefer projects in their living area is not directly applicable in policymaking.

However, this study shows that individuals do not only select projects in their living area. The results show different strategies and interests come together in PVE, being among else economic interests (e.g., projects in living area), social interests (e.g., safety compliance), and ethical interests (e.g., spatial equality). Providing information on project locations enables exploring the combination of these interests. Furthermore, this setting, including the location of projects, explores among else to what extent individuals account for spatial-equality by allocating budget to other living areas instead of their living area.

4.2 PVE compared to CBA

The PVE expert argues that the location-effect is in line with the concept of PVE. The setting of PVE aims to allow participants to apply whatever strategy they prefer. If individuals prefer to include projects located in their living area, these results reflect their preferred strategy. In contrast, the CBA expert stated it would be problematic if individuals would only select projects in their living area since less complex tools could be used to measure that.

However, the results show that the experiment does not only measure individuals selecting projects in their living area.

4.3 Policy implications

The scientific CBA and PVE experts argue that an evaluation method like PVE should provide accurate information to policymakers. It is up to policymakers what to do with the results.

Policymakers argue that knowing that citizens prefer projects in their living area over projects in other areas is not useful information for policymaking. However, it makes sense that individuals include a project in their living area to their portfolio. Individuals are more likely to know these traffic situations and make use of it. Consequently, the urgency of a project would be questionable when individuals living close to the project would not select the project.

Apart from this, individuals select projects spread located over the region, which indicates citizens attach value to spatial-equality. The local government does not apply strict guidelines for spatial-equality to their program of investments. According to this study, if policymakers are willing to respond to citizens' preferences, the program of investment should account for spatial-equality.

Instead of strict guidelines for the budget allocated to each region, the regional government had these guidelines for the budget allocated to each of the modalities. However, the regional government of Amsterdam decided to switch from a fixed budget per travel modality to a flexible budget. This study shows that citizens do not compose the portfolio based on modalities but rather the location of projects. Consequently, regional governments should better apply guidelines for spatial- than modality distribution.

5. Conclusion

The distributed profiles identified in this study showed three types of strategies, being 1) selecting projects in their living area, 2) selecting as many low costs projects, and 3) allocating a large share of the budget towards safety compliance. Most individuals apply a combination of these strategies, where most individuals (60 to 94 percent per living area) include at least one project located in their living area to their portfolio. Consequently, a strong location-effect occurs.

This study showed that projects are predominantly selected based on project *location*, project *costs*, and improvement of *safety compliance*. In contrast, quantitative attributes had no effect. It is questionable to what extent individuals consider these values. Also, no clusters based on travel mode were identified. No background relations with favorite travel mode nor political orientation were found. Consequently, bikers do not predominantly select bike projects, and environmentally-oriented respondents do not consider only minimal environmental impacts.

In addition, the study showed that demographic variables such as gender, age, and education are significantly related to project preference. Women and individuals between the age of 20 and 40 are more likely to select safety compliance projects. Higher educated respondents are more likely to select low costs projects spread over the whole region, while lower educated respondents are more likely to select projects within their living area. Individuals' income, having a driving license and having a PT commutation had no significant effect.

Individuals selecting projects in their living area is in line with the concept of PVE. The location-effect does not contradict the concept of PVE since it correctly reflects individuals' preference for spatial-infrastructure projects. Consequently, individuals should be allowed to select projects in their living area. However, if the location-effect would be the only effect that exists in PVE experiments, methodologies that are less complex than PVE can be used to measure that effect.

This study shows that individuals do not *only* select projects in their living area. However, it is important to be aware of it and to control for the location-effect.

To what extent the location effect is desirable depends on the aim of the experiment. For the evaluation of alternative effects of a project, the location-effect dominating these effects might be undesirable.

6. Discussion

6.1 Implications

Theoretical implications evaluation citizens preferences

The main finding of this study is the location-effect, which implicates participants' tendency to select those projects that are close to the location where they live. Consequently, whether researchers control for the location-effect or not, they have to be aware of the existence of a strong location-effect.

Apart from the location-effect, the results show that individuals do include several low-costs spread located over the region, which might indicate a preference for spatial-equality. The results also showed that higher educated respondents are more likely to select various low-cost projects spread over the region, while lower educated respondents are more likely to predominantly select projects close to their living area. It could be lower educated respondents have more difficulties with the complexity of the tool. However, Mouter et al. (2017) found the same relation between education and preference for spatial equality using a more simplistic design. Consequently, the study shows that citizens do attach value to spatial-equality.

PVE methodology implications

A problematic implication of the location-effect, where experts agree on, is that the welfare increase of projects in the overrepresented living area is overestimated. Therefore, the optimal portfolio analysis should correct for representative living areas to reflect the average ranking of projects.

Furthermore, this study shows that the closer a project is located to individuals' living location, the more likely individuals select the project. These results indicate that individuals assign more value to a project closer located to their living location. Consequently, in cases the location-effect exists, the PVE welfare computation should include an estimated parameter for this distance. The estimated distance parameter should probably be included in the individuals' utility function of the MCDEV model described by Dekker et al. (2019), which describes the welfare increase for individual citizens due to a project. It is expected, according to the findings of this study, the distance parameter would be negative for spatial-infrastructure projects. Further research should identify how the model should exactly cover for the location-effect.

The results show that project selection is predominantly based on *project location, project costs,* and improvement of *safety compliance,* which information was all included in the title of projects. The titles of all projects were presented to participants in the overview page. These results indicate that individuals do predominantly base their choice on the information provided in the titles of the projects. Consequently, the information presented in the project title does affect what projects individuals selected. Future experiments should carefully consider the information presented in the project title. For example, if one would decrease the location-effect, not naming the location in the project title can be considered. On the other hand, attribute values like the number of trees cut might have more impact on participants' decision-making process by naming it in the project title.

Policy implications

The location-effect implicates projects in high populated areas are higher ranked than projects in more remote areas. However, more strategies than individuals selecting projects in their living area are visible. The distributed results show the reasons policymakers needs, as stated by the theory of Nyborg (2012). This study shows individuals prefer projects 1) close to their living area, 2) that improve safety compliance, or 3) that have low costs (spread over the region). These insights provide a reason to 1) allocate *more* budget to the high populated areas than low populated areas and 2) allocate budget to safety compliance. Furthermore, these insights provide a reason to 3) include low costs projects, which are spread over the region, to the agenda of investments.

In terms of transport planning, these results incorporate citizen participation on a higher level, where citizen strategy over a bunch of projects is evaluated instead of an individual project. The strategies preferred by citizens can be compared to the total combination of projects on the agenda of investment. For example, if a large share is allocated to safety compliance.

6.2 Limitations and recommendations

No information about participants' travel behavior was available. This information is useful to explain individuals' choices better. For instance, participants might select projects improving the infrastructure they have to make frequent use of. An additional question is recommended for a future experiment, which asks participants' work location since that is probably the location individuals most frequently travel to.

Furthermore, the dataset contains only information if projects are in the optimal portfolio or not. One of the limitations is that no information was available whether projects are individuals' first choice or selected as a 'budget-filler.' The scientific PVE expert suggested that participants should rank the proposed projects. If participants have to rank the projects included in their portfolio, valuable information would be gathered. For example, if individuals prefer safety compliance projects over other projects in their living area.

6.3 Further research

This study shows that individuals are more likely to select projects close to their living location than projects located far-off their living area. The statistics suggest a negative relation between the distance from individuals' living location to the project location and individuals' expected utility due to the project. Further research should identify the extent of the relationship more precisely by using individuals living location and the distance to the project location. This research could show whether this relation is linear or from what distance range (in kilometers) projects become less likely to select. The estimated parameter for distance from individuals living location to project location could be used in the MCDEV model to more accurately determine societal welfare increase due to a project. Further research should identify how welfare computation should account for the location-effect.

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